Extra-team connections for knowledge transfer between staff teams

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Abstract

As organizations implement novel health promotion programs across multiple sites, they face great challenges related to knowledge management. Staff social networks may be a useful medium for transferring program-related knowledge in multi-site implementation efforts. To study this potential, we focused on the role of extra-team connections (ties between staff members based in different site teams) as potential channels for knowledge sharing. Data come from a cross-sectional study of afterschool childcare staff implementing a health promotion program at 20 urban sites of the Young Men's Christian Association of Greater Boston. We conducted a sociometric social network analysis and attempted a census of 91 program staff members. We surveyed 80 individuals, and included 73 coordinators and general staff, who lead and support implementation, respectively, in this study. A multiple linear regression model demonstrated a positive relationship between extra-team connections ($\beta = 3.41$, $P < 0.0001$) and skill receipt, a measure of knowledge transfer. We also found that intra-team connections (within-team ties between staff members) were also positively related to skill receipt. Connections between teams appear to support knowledge transfer in this network, but likely require greater active facilitation, perhaps via organizational changes. Further research on extra-team connections and knowledge transfer in low-resource, high turnover environments is needed.

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Introduction

Institutions that address the needs of children and youth, such as schools and afterschool childcare programs, have recently been the focus of much attention as potential channels for delivery of health promotion programs [1, 2]. Afterschool programs show great promise for disseminating such programs given their mission, a structure that supports program delivery [3], and their reach of ~6.5 million children served annually in the United States [4]. Yet, a major challenge for effective dissemination of health promotion programs is the implementation stage, in which organizations incorporate and scale up programs [5, 6]. Many barriers to implementation are organizational in nature as institutions must evolve to allow for incorporation of a new program or way of work across multiple sites [6]. According to the Institute for Healthcare Improvement [7], the spread of new practices within an organization, or internal spread, can be facilitated by a range of organizational supports, including: targeted leadership responsibilities, identification of improved ideas, strong communication and social systems, a monitoring system and effective knowledge management. In this study, we focus on two of these supports: knowledge management and communication/social systems.

Knowledge management is a key driver of implementation processes as the spread of knowledge between and within sites allows for faithful and sustainable implementation of the program of interest [8, 9]. As conceptualized by Nonaka and Takeuchi [10, 11], knowledge can be categorized as either explicit or tacit. The former can be communicated formally, e.g. in manuals, and expresses the 'what' of implementation. Yet, much value and competitive advantage comes from spreading tacit knowledge, which focuses on the 'why' and 'how' of implementation. A comprehensive review of implementation in health promotion programs by Fixsen *et al*. [5] found that great strength for supporting implementation comes in the form of spreading tacit knowledge relating to the program. This knowledge is context specific, difficult to systematize and depends on connections actively fostered between staff members and experts within and outside the organization, as well as with the target audience [12].

Communication and social systems are crucial for spread of innovations as they serve as channels for the spread of information. We can understand these systems as social networks that impact diffusion and dissemination of programs, as exemplified by the work of Rogers [13] and more recently Greenhalgh *et al*. [6]. The staff social network, or the web of relationships among employees [14], provides channels for exchange of resources among individuals and teams, including the spread of innovative ideas among staff. The number and quality of staff members' contacts have been linked with individual and team performance [15]. In the case of multi-site implementation, the staff network serves multiple functions, including supporting training efforts and also allowing for spread of best practices and internally developed knowledge and adaptations. Here, we assess the ability of the staff social network to spread tacit program-related knowledge. Examples include transfer of key adaptations or results of experimentation and findings that result from revisiting base assumptions [12].

Using the Fixsen model [5], we see improvement of the practitioner knowledge base to be a key implementation outcome. Other outcomes include practitioner knowledge and skills, changes in the organizational structure to support practitioner behavior change and changes in relationships with important partners, such as consumers or systems partners. This model also includes intervention outcomes, changes in target audience behavior and health outcomes. In previous work [16], we found that the staff network may support formal training efforts by provide informal training opportunities. Specifically, we found that the number of connections reported to colleagues was linked with reports of learning program-related skills. Here, we extend the analysis to focus on a subset of staff connections that may be useful for knowledge transfer between site-based implementation teams. Though network analysis is an established field, applications to health promotion and prevention can be greatly increased [17, 18]; additionally most studies focus on interactions between interdisciplinary teams, not those engaging in the same work in multiple locations [19]. This study contributes to the literature by assessing ways to utilize an existing resource, the staff social network, to support health promotion program spread across multiple sites of the same organization.

Extra-team connections for knowledge sharing

Given that implementation of innovative programs across multiple sites relies on knowledge sharing between site teams [8], we were interested in connections that exist in networks outside of site teams, but within the organization, referred to here as 'extra-team connections' [20]. As in many organizations, the team is often the functional unit of interest for afterschool childcare programs [21]. Extra-team connections result in improved team performance [8] as team members acquire diverse, novel knowledge to meet their goals [19, 22]. Though extra-team connections may extract a cost in terms of attention and time spent managing relationships [20, 23], they appear to be an important long-term investment [24]. Key organizational barriers to knowledge transfer between teams are lack of support or reward for such transfer and lack of a system by which to share knowledge [19]. Extra-team

connections serve as an important complement to 'intra-team connections', or connections among members of the same team, which benefit productivity [21] by building alignment of group actions with common goals [25].

In this analysis, we studied the role of extra-team connections for knowledge transfer between afterschool childcare sites of the Young Men's Christian Association (YMCA) of Greater Boston implementing a novel health promotion program. The YMCA provides a useful example given that the organization is focusing on effective knowledge management as part of a movement toward becoming a learning organization [26]. The goals of this study were to: (i) characterize the distribution of extra-team connections in a network of staff engaged in multi-site implementation of a novel program and (ii) describe the relationship between these connections and a marker of knowledge transfer.

Methods

Setting and design

In 2005, the YMCA of Greater Boston invited 24 of 37 urban afterschool sites to participate in a 3-year health promotion project funded by US Department of Education's Carol White Physical Education Program. The sites were chosen by YMCA management based on past success with delivery of novel curricula and programs. Approximately 700 children attended these programs; roughly 70% of whom received need-based financial assistance. The racial/ethnic makeup of the population of children served was estimated as: 45% White, 37% African-American, 15% Hispanic/Latino and 3% Asian/Pacific Islander or Other [27].

In the fall of 2005, the 24 sites began to implement the iPLAY program, a set of health promotion and organizational changes guided by the YMCA of the USA and the Institute for Healthcare Improvement Breakthrough Series model [8], with evaluation assistance from scientists at the Harvard School of Public Health. The program targeted improvements in (i) physical activity, (ii) nutrition, (iii) connections between staff and children and

parents/guardians and (iv) screen time (time spent with television and videos). Staff were also charged with using experimentation and data-driven decision making to identify best practices for implementation within and across teams. Thus, communication and spread of ideas between teams was an explicit goal for implementation.

Quarterly mandatory training sessions were delivered to coordinators from each site, who were expected to share information with other coordinators, as well as colleagues at their sites. Training and technical assistance were provided by the program director, the individual hired to support iPLAY program implementation during the 3-year grant period. For this study, staff reported on their personal characteristics and professional relationships with colleagues in November and December 2007 using a self-administered survey. The Human Subjects Committee at the Harvard School of Public Health approved this study.

Respondents

Twenty of the 24 sites were still implementing the program when this study began, 26 months after program inception. These 20 sites were overseen by eight branches, which in conjunction with another eight branches comprise the YMCA of Greater Boston. All 91 staff members at these sites who provide childcare and were on the staff roster on 1 November 2007 were invited to participate in the study. A total of 80 staff members took the survey, yielding a response rate of 88%. Nonresponders were either absent during survey administration (10) or left the organization before being surveyed (1).

Of the 80 respondents, two categories of staff members were included in this analysis: 20 coordinators (implementation leaders) and 53 general staff members (individuals who supported program implementation). The 20 coordinators represent 19 sites as the coordinator at one site left the organization before being interviewed and another site employed two coordinators. We excluded data from seven supervisors as their job functions prevent useful comparisons with coordinators and general staff. Given our interest in measuring sustainable

channels for knowledge transfer between site teams, we did not survey the program director. This person neither was a member of a site team nor was his position a permanent part of the program (it only existed for the 3-year grant period) and thus would not be a lasting component of the program. For these reasons, we restricted our focus to members of site teams.

Measures

To collect our network data, we utilized standard social network analysis data collection procedures [23, 28]. We defined our network based on interactions related to the iPLAY program and asked staff members to list colleagues with whom they interacted for 'sharing information, skills or talking through challenges and successes' regarding the program. Using the roster method, we presented respondents with a list of staff members involved in the iPLAY program; there was no limit on the number of individuals they could list. Reports of network connections based on this methodology have shown strong construct validity through triangulation between individual and peer reports [29]. We focused on routine program-related interactions, rather than activities in a specific time period, for increased validity [30].

Independent variable

The independent variable of interest was extra-team connections or the number of connections noted by respondents to iPLAY colleagues in other teams. This measure is based on directional relations between individuals [28], which means that each connection has a source (the respondent) and a destination (the contact who was listed). We focused on the subset of connections reported by the respondent about others as these connections may be perceived as functionally useful to the respondent. Here this function may be related to the ability to gain resources from listed contacts.

Dependent variable

We utilized a marker of knowledge transfer, skill receipt, as our dependent variable. After listing program-related contacts, respondents were asked if they gained any of a set of six skills from these colleagues. The six skills were those targeted by the program training curriculum: connecting with children, connecting with parents, program planning, program implementation, data analysis and program evaluation. The variable skill receipt is the total number of skill receipt reports across the six skills. If a respondent noted two important contacts and noted gaining three and five skills respectively from those contacts, the skill receipt value would be 8. Studies of skill gains among teachers suggest that individuals are able to accurately self-report gaining novel skills [31].

Other important variables

An important complement to extra-team connections is the variable intra-team connections, which measures connections noted by respondents to colleagues based on the same team. Again, the focus is on connections reported by respondents to others, which indicates that the relationship may be useful to the respondent. To provide context for our measures of extra- and intra-team connections, we also present descriptive measures that take into account tie direction. 'Out-degree' is the number of individuals nominated by a respondent [32] and defines the group from whom knowledge might also be gained. 'In-degree' is a complement to out-degree and is defined as the number of individuals who listed the respondent as an important contact, here with relation to the iPLAY program.

Analysis

We conducted a sociometric network analysis, in which we assessed all members of the bounded social network [33] to identify channels of communication that can support knowledge transfer between teams. The network analysis included all respondents and nominated colleagues in the network, specifically the members of 20 site teams engaged in implementing the iPLAY program. Thus, an individual who was invited to participate, but did not fill out a survey, may exist in the dataset if he/she was nominated by a respondent.

Network analysis requires dedicated software to assess relational data; we used UCINET-6 [34] for this purpose. Network data observations are not independent; therefore, the assumptions of statistical inference supporting classical regression techniques cannot be met. Thus, we utilized techniques developed for network data, specifically the *t*-test and regression procedures in UCINET [34, 35]. The major difference is that the significance tests are appropriate as they are based on random permutations of matrices. Here, the significance levels were determined based on distributions created from 10 000 random permutations.

We constructed a multiple linear regression model to estimate the relationship between extra-team connections and skill receipt. The data met requirements for linear regression in their original form. The initial model included our predictor of interest as well as several covariates selected due to their theoretical relevance in the implementation literature, including: Intra-team connections, staff gender, tenure in years with the YMCA, position (general staff or coordinator) and number of staff members at the site. We removed the variable position due to its high correlation with the dependent variables [36] ($r = 0.41$). We removed covariates that were non-significant (P value > 0.05) and whose removal did not change the parameter estimates of remaining variables by >10%. The final version of the model included only the dependent and independent variables of interest, as well as intra-team connections.

Results

Staff characteristics

As seen from Table I, general staff members tended to be young (under 25), worked part-time, reported a high school education or some college/an associate's degree. As a group, coordinators tended to be older, had higher education levels, worked more hours each week at the YMCA and had longer tenure than general staff. Differences between groups were statistically significant for education levels, weekly hours spent at the YMCA and tenure; differences in age between groups were borderline significant ($P = 0.06$). Among general staff and

coordinators, substantial percentages of staff (67 and 30%, respectively) reported <2 years experience with YMCA Afterschool Programs, meaning that they began working with the program after iPLAY implementation began. We also noted that coordinators (compared with general staff) reported significantly higher numbers of connections to others (out-degree) and were also nominated by others (in-degree) more than general staff ($P < 0.001$ for both comparisons).

Network and team-level analysis

Overall, the network had density of 0.02, meaning that only 2% of potential connections were realized in the network. As seen in Fig. 1, connections between teams were less common than those within teams. We found a total of 57 out of 6151 (~1%) of potential extra-team connections were reported, compared with 91 of 346 (~26%) of intra-team connections. We found that two teams reported zero extra-team connections. The average was 2.85 [standard deviation (SD) = 1.72]. For intra-team connections, two teams reported zero intra-team connections (related to the program), with an average of 4.55 connections (SD = 6.48). Teams of staff members are based in sites, which are nested within branches (the higher organizational unit). Most external links (48 of 57) occurred between teams based in sites belonging to the same branch.

Individual-level analysis

Coordinators averaged 1.80 extra-team connections (SD = 1.74). Seventeen of 20 coordinators reported at least one extra-team connection. Over two-thirds of general staff (68%) reported zero extra-team connections, with an average of 0.40 (SD = 0.63). The difference in average number of extra-team connections between coordinators and general staff was statistically significant ($P < 0.001$). For intra-team connections, coordinators averaged 2.05 connections (SD = 2.78), compared with an average of 0.94 (SD = 0.72) for general staff, a borderline statistically significant difference ($P = 0.06$). Also, although our analysis excluded the program director, in a separate assessment, a total of 27%

Table I. *Descriptive data: staff characteristics and connection patterns (n = 73)*

Variable	All (n = 73)	General staff (n = 53)	Coordinators (n = 20)	Comparison of general staff and coordinators
	%	%	%	
Position				n/a
General site staff	72.60	100.00	n/a	
Coordinator	27.40	n/a	100.00	
Age				+
Younger than 25	78.08	84.91	60.00	
25–34	15.07	9.43	30.00	
35+	2.74	5.61	10.00	
Gender				ns
Female	65.75	60.38	80.00	
Male	34.25	39.62	20.00	
Highest level of education completed				*
High school or less	46.58	54.72	25.00	
Some college/associate's degree	46.58	41.51	60.00	
Bachelor's degree or higher	6.85	3.77	15.00	
Hours worked at YMCA each week				**
20 hours or less	43.84	52.83	20.00	
21–30 hours	28.77	32.08	20.00	
31–40 + hours	27.40	15.09	60.00	
Years with YMCA afterschool programs				*
<1 year	31.72	44.23	10.00	
1 year to <2 years	22.22	23.08	20.00	
2 years to <5 years	29.17	23.08	45.00	
≥5 years	13.89	9.62	25.00	
Out-degree: mean (SD)	1.85 (1.91)	1.28 (1.00)	3.35 (2.80)	**
In-degree: mean (SD)	1.85 (1.91)	1.28 (1.35)	3.35 (2.16)	**

$+P < 0.10$; $*P < 0.05$; and $**P < 0.01$ for results of contingency table tests for categorical variables and *t*-tests for comparison of means.

of respondents (75% of coordinators and 13% of general staff) noted a connection to that individual.

In the multiple linear regression analysis, presented in Table II, extra-team connections were positively associated with skill receipt (β = 3.41, $P < 0.0001$), independent of the covariate. Similarly, intra-team connections was positively associated with skill receipt (β = 1.50, P = 0.004), independent of other variables. The R^2 value for this model was 0.58 and the adjusted R^2 was 0.56.

Discussion

Our findings not only support the management mandate to create channels between teams for knowledge transfer but also suggest that creation and utilization of such links may require greater active facilitation. The investment in connections between teams may allow the organization to spread tacit program-related knowledge between sites [8], thus allowing the organization to change continuously and maintain competitiveness in the market [37, 38]. We found that respondents who reported higher numbers of extra-team connections reported higher levels of skill receipt, our measure of knowledge transfer. We also found that the number of intra-team connections was positively related to skill receipt, though with a smaller effect. The number of intra- and extra-team connections explained a large amount (58%) of the variance in skill receipt, pointing to the importance of these connections.
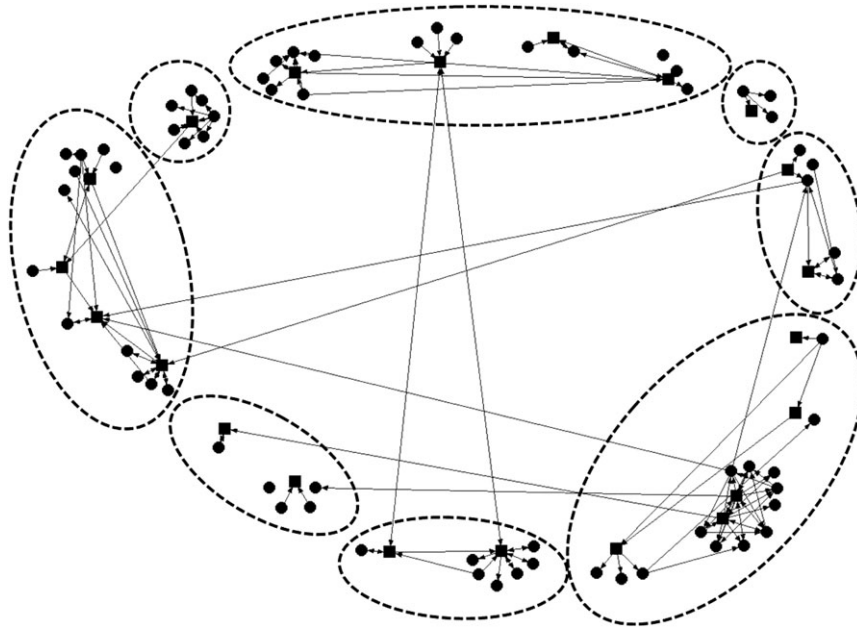
Fig. 1. Network diagram representing program-related connections among program staff (*n* = 73). Black circles represent general staff; black squares represent coordinators. Individuals are clustered by site teams and dotted ellipses show branch membership of sites.

Table II. *Association between extra- and intra-team connections and skill receipt among staff involved in a multi-site implementation project (n = 73)*

Variable	Beta estimate[a]	Significance (*P*-value)
Intercept	1.80	<0.0001
Extra-team connections	3.41	<0.0001
Intra-team connections	1.50	0.004
R^2 = 0.58, adjusted R^2 = 0.56		

[a]Estimate derived from multiple linear regression model, unstandardized coefficients presented.

Despite the potential utility of links between teams, we found that in this network, only 1% of such potential linkages existed. The low numbers of extra-team connections in the network may reflect the difficulty and investment required for building such connections [23]. Although there is likely to be a threshold for the marginal utility of additional connections between teams, this network will likely benefit from great extra-team connections. Similarly,

the extra-team focus must be developed in relation to the intra-team connections, as too much of an extra-team focus may negatively impact the team's efficiency [39]. When assessing the base network structure for knowledge transfer between teams, we found that 17 of 20 coordinators (those charged with leading implementation) and 18 of 20 teams reported at least one extra-team connection. Though a normative level of connectivity is not defined by the literature, the isolation of some teams and leaders suggests the need for intervention. Cross-sectional data prevented us from determining whether individuals tapped into existing connections for knowledge transfer, or if they actively sought out expertise among their peers, thus simultaneously increasing the number of connections and skill receipt transactions. Regardless of the direction of this influence, we expect that higher levels of connectivity will increase access to knowledge [22].

In addition to knowledge transfer, increased connection between teams may offer a protective effect for knowledge management in the network

as a whole, given the high levels of turnover among staff. This is an endemic problem in after-school childcare programs, with annual staff turnover rates estimated between 25 and 40% annually [40, 41]. For this program, over half of staff members joined the organization after program implementation had begun. High turnover results in reduced connections among staff [42], loss of tacit knowledge from the organization [43] and reduced performance [44] and improved knowledge transfer between teams can buffer the effects of such loss of staff.

The question remains as to how organizations might increase the level of connections between site teams implementing novel programs. Active development and support of connections between teams by the larger organization appears to be key for success in supporting tacit knowledge transfer between teams and creating a learning organization [12]. By routinizing opportunities to meet with and learn from other teams and a network of experts within the organization, strong channels for knowledge transfer can be developed [7, 12, 43]. For example, in this network, coordinators may have reported higher numbers of extra-team connections than general staff because they had greater opportunities and obligation to network with colleagues at other sites regarding the program. The organization can also encourage teams to assess resources they possess as a group versus those they need to access via members of other teams [15].

It may also be useful to target connections between teams that take advantage of the organization's structure [7]. In this organization, afterschool childcare programs are run by teams based in sites, sites are overseen by a branch and 16 branches comprise the YMCA of Greater Boston. The relationship between sites and branches is similar to that between schools and school districts. About 85% of links between teams occurred between individuals in sites overseen by the same branch, which may be a function of physical proximity of sites, shared space for teamwork and facilitated opportunities to interact for other purposes. Structural supports for collaboration, such as proximity and co-location, support productive interactions between individuals from different teams [45, 46] and should be utilized fully. Nonetheless, knowledge worthy of transfer may be gained anywhere in the organization, so over-reliance on proximity as a determinant of communication channels should be avoided.

Another important structural support for connections between teams may come from the person supervising the implementation process. In this network, low levels of connections between teams may also reflect reliance on the program director, who often served as the conduit for information between sites. About one-quarter of staff members noted a connection to the program director, yet the group that connected with this individual was predominantly composed of coordinators, who were charged with knowledge sharing between sites, so the impact of such a position may have had a substitution effect. Senior management may need to take a long-term perspective regarding building a knowledge-sharing network at the intermediate expense of using someone in this position to circulate knowledge and impact implementation quickly [22, 24]. Overall, many of these solutions point to opportunities to use organization-level changes to better support implementation.

Limitations and strengths

The findings should be interpreted with a few key limitations in mind. The first limitation relates to the validity of our measures of program-related connections and skill receipt, which were collected via self-report data and are subject to social desirability bias. Though we do not have reliability or validity data for the questions used, the literature suggests that our methods were appropriate [29, 31]. The second limitation relates to external validity, a common issue facing network and team research [21]. This analysis is limited to one network of non-randomly selected sites, thus findings may not be generalizable to other networks, as organizational context has a strong impact on network structures, resources and functions [6]. Third, the data in this study are cross sectional; therefore, causation

cannot be determined, though alternative explanations also support our interpretation.

Despite these limitations, the assessment of extra-team connections in a low-resource, high-turnover service organization is a useful addition to the literature as the majority of assessments focus on professional settings. This study is strengthened by a high response rate (88%) as well as the use of sociometric analysis of a clearly defined network, which allowed us to examine relationships among all individuals in the network as well as the resources contained within those relationships. The study also points to the utility of using social network analysis to evaluate knowledge transfer among staff and the successes or gaps in attempts to create a learning organization.

Implications

Given the potential utility of extra-team connections for spreading knowledge in multi-site implementation projects, further study is warranted. Next steps include testing the relationship between extra-team connections and transfer of program-related knowledge and skills utilizing more objective measures of knowledge transfer. Also, further investigation into the complementary roles of extra- and intra-team connections will point to ways in which information brought into the team can best be utilized and integrated into the team's work [47]. The continued focus on channels for knowledge transfer between teams in low-resource, high turnover environments has great practical utility. Given the high cost of developing and maintaining connections in a network, and particularly extra-team connections, these connections must be developed strategically, with an eye on the ultimate goal and successful implementation of the program.

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